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ABSTRACT

The Educational Center for Disabled Students at the University of Nebraska-Lincoln is designed to improve the academic performance and attitudes toward success of disabled students through computer technology and academic skills training. Adaptive equipment interventions take into account keyboard access and screen and voice output. Non-adaptive equipment needs, those not originally designed for the disabled, have also been examined. Examples of the latter type include optical scanning devices, lap computers and silent typewriters for notetaking, and a mouse input device for drawing. The computer and various kinds of software are used as skill training interventions to overcome such difficulties as inability to manipulate writing tools, inability to see materials and format written script on paper, and difficulty producing readable text due to letter transformations, organization, and spelling problems. (CL)

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COMPUTER TECHNOLOGY AND ACADEMIC SKILL TRAINING FOR IMPROVING DISABLED STUDENTS' ACADEMIC PERFORMANCE: APPLICATIONS AND LIMITATIONS

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The Educational Center for Disabled Students at the University of Nebraska-Lincoln was established by a grant from the U.S. Department of Education in August, 1985.

The main purpose of the Center is to improve disabled students' academic performance and attitudes toward success in college through the use of computer technology and academic skills training. Extra time is often needed to complete course assignments for these students. Computer technology can provide a way to compensate for disability-related limitations in completing college coursework.

This presentation will describe the types of equipment and software the Center utilizes and how they are integrated with academic skills training to assist disabled students in performing successfully in their classes.

Identification of Students' Needs

Through data collected from students' needs assessments, the Center staff determined that equipment was needed for physical disability, visual impairment, hearing impairment, speech impairment and learning disability. Two intervention purposes for the equipment were focused on for purchase: 1) equipment to allow students with physical disabilities access to the computer keyboard for entry, and to a monitor for output; and 2) software that would allow the computer to be used as a technological aid for disabled students to assist them in meeting course demands for writing, studying, and notetaking.

The process of matching equipment and software to

students' needs constitutes the intervention strategies of the Center. These strategies are based on the general types of disabilities served and the technological and skill training assistance available in the Center.

Adaptive Equipment Interventions

Keyboard Access

Some physical disabilities limit the student's ability to type and operate keys on the keyboard. Even when keyboard access is possible, the physical disability may severely restrict the speed at which typing can be accomplished; diminishing the benefit of using the computer as a writing tool.

Most of the alternative entry methods researched by the Center's staff were developed either for an early childhood special education context or for the field of augmentative communication. These methods were found not to be feasible because they were not designed to allow high volume or high speed entry as the tasks they were designed to do did not require a high volume of data.

A critical need was for college students to be able to use the computer to complete assignments that sometimes require a large amount of data entry. A presentation by Jack Heller at a Closing the Gap conference indicated that direct keyboarding could be managed by physically disabled students even if they could only operate a single stick or head stick. He developed a program to teach touch typing skills to a broad range of disability conditions. Documented success of

his students indicated that effective use of the computer could be made through keyboard access, at acceptable rates of speed, by most physically disabled students.

The Heller program was obtained from McGraw-Hill and training for it was combined with computerized typing instruction using the Typing Tutor program to train students in keyboarding using a touch typing method. For students with any ability to access the keyboard this method appears to be the best way to provide computer access at an acceptable rate of speed.

The Center also selected an alternative input system for students who had no ability to access a keyboard. The Words+ system of alternative input was identified as a practical alternative input method that could meet the needs of college students. The Words+ system uses a multi-dimensional scanning system based on words rather than the alphabet. The user is able to scan a 2400 word vocabulary that can be customized, and enters a word at a time into text rather than having to spell each word. An additional benefit of the system is that it contains a word prediction feature that will anticipate the next word to be used in a text based on a writer's past usage pattern. Input speeds of up to 20 words per minute are possible with this system.

An appealing feature of the Words+ system was its use of an IBM personal computer as the main system component. The Words+ scanning process operates from programed software rather than requiring equipment modifications. Switch access

is obtained from an inexpensive plug-in input device that runs through a standard input/output port on the computer. The entire system is easily updated by adding new software and would be easily usable on any IBM computer. This makes the system appealing for the work environment since businesses could create work stations for the disabled with no physical modifications to their existing equipment.

The Words+ system for the IBM, and the similar Adaptive Firmware Card for Apple computers, provided the Center with alternative accessing methods; and the Heller typing instruction program provided a way to access the keyboard itself. These methods allowed the Center to address the range of potential need for alternative input methods for the physically disabled.

Screen and Voice Output

Although visually impaired students could access the standard keyboard, and in many cases already knew how to type, they experienced difficulty with reading type on the standard computer monitor. Three methods of providing alternative screen output for the visually impaired were examined: 1) large print display; 2) voice output; and 3) printed braille output.

For low vision students, the large print display monitor was very effective. The display system chosen by the Center was the Visual Tech Large Print Monitor and Processor. This device provides a nineteen (19) inch diagonal screen and can be used with any commercially available software. The device

provides for complete operator control of enlargement size and how the display is presented. Enlargement is available in a range from twice normal size up to sixteen times normal size (5 inch letters). The display can be presented on the entire screen or a single line can be isolated. Movement across the screen can be done manually or the screen can be set to scan line by line automatically. The speed of scanning is user adjustable. This display system appeared to be the best available for providing large print display in terms of quality, variety of features, and ease of operation. The system could also be attached to any computer system, either in place of the normal screen or in addition to the normal screen.

For the totally blind user, the remaining options were voice output and braille print output. A variety of talking and braille output work stations were available. While of high quality, these specialized stations were expensive and used non-standard computers with specialized software.

In order to obtain voice output on the systems being used in the Center the staff identified two voice synthesizers that could be attached as peripherals to any standard computer: the Votrax and DecTalk. The Votrax provided a reasonable quality of speech with the ability to customize the unit to handle difficult or non-standard pronunciations at a low cost. Units could be obtained in the 300 - 400 dollar price range, making the Votrax reasonable for purchase by students for personal use. The DecTalk

synthesizer was superior in quality to the Votrax; however, it was prohibitively expensive. The Center was able to obtain one DecTalk synthesizer through a grant from the manufacturer (Digital Equipment Corporation) that reduced the price from the normal $4000 to $1600. Since the voice quality is much higher on these synthesizers, the Center wanted one high quality machine for training and demonstration purposes.

Another output problem results from speech disability. Students who have speech problems are often unable to participate in class discussions or ask questions during class. This limits their access to information by restricting their interaction with other students or the instructor, and limits their ability to clarify material they do not understand. This problem affects speech impaired students and students with other disabilities (ie. Cerebral Palsey) that affect the ability to speak clearly.

For these students, voice output from a standard computer or a portable computer can be utilized to replace normal speech. Phrases and questions can be entered by normal accessing methods or by preprogramming a set of phrases into the computer, and the computer can then output these phrases through the voice synthesizer. This allows students to ask questions and participate in oral discussions.

Voice output requires a software program that can intercept output going to the screen and direct it to the

synthesizer for speaking. Two types of speaking software exist: 1) dedicated speaking programs; and 2) general purpose speaking software which provides access to a variety of software.

A number of programs were available that could provide speech output from other programs. This software allowed the user to run standard programs, such as the PFS series used in the Center, in the regular manner with the addition of voiced screen output. This appeared to be the preferred method of voice output since it would allow any program to be voiced and would be usable in the business environment where a variety of programs would need to be used.

The Screen Talk program from Computer Aids Corporation was chosen for the IBM systems because it could voice most standard IBM programs, including the PFS series, and was reasonably priced.

Braille output is available through the use of a braille printer. These devices operate as a peripheral device much like a standard printer. Braille printers do, however, require special translation programs to create the braille print. Like the voice output programs, dedicated braille programs are available that combine braille print with a functional program, such as a word processor, or general braille translation programs are available that can translate the output from other software.

Non-Adaptive Technological Interventions

As other needs were identified, the Center's staff

looked to other types of equipment generally available to the business community and, although not specifically designed to compensate for the disabled user, might be useful to them in their educational pursuits.

Optical Scanning

One need that was identified was the ability to input preprinted data into the computer through the use of an optical scanning device. Visually impaired students often needed to obtain written materials from periodicals or other sources that were not readily obtainable in large print or on audio cassette.

The staff identified a variety of optical scanning devices which could be utilized to read pre-printed material into the computer. Most available scanners were over $10,000 making them prohibitively expensive. An additional problem was that most were designed to scan original typewritten text rather than material printed in textbook or periodical form. Thus, many were incapable of reading double column text or the small print sizes in printed books and periodicals.

The Center staff identified a low cost optical reader (the Omni Reader) that could be obtained to pilot the usability of these devices. Two of these devices were obtained. While the Omni Reader is relatively unsophisticated and requires manual movement of the scanner, it is able to read the material in books and periodicals and will allow the Center to determine the usability of these devices. If they prove usable more sophisticated equipment

will be considered.

Lap Computers and Silent Typewriters

A potential need to use equipment for notetaking was examined. Many of the students using the Center were unable to take their own class notes and relied on notetakers to obtain notes. This process creates problems with consistency of obtaining notes and understanding notes taken by another person. The staff determined that it would be beneficial if computers could be used to allow disabled students to take their own notes.

Two types of equipment were identified that could meet this need. The first was portable silent typewriters. The Canon corporation made a lightweight silent typewriter that could be carried to class by the student. A second solution was to use the new lap-top portable computers. A number of companies make notebook size computers that can run word processing and other software. These could be transported to class and the notes could be transferred to disk on the Center's desktop computers or printed on the Center's printers for hard copy. Some of the notebook computers are also able to run specialized software that allows entire phrases to be accessed by a single command. This could decrease the amount of writing needed to obtain complete notes.

One Canon Typestar 5 typewriter and five TRS 80 lap top computers have been obtained. This equipment will be used to test the feasibility of class notetaking. This particular

equipment was selected for its low cost ($200-300 per unit). Newer IBM compatible lap top computers are now on the market, though at a higher cost ($1300-2500). For testing purposes the Center acquired one IBM Convertible lap-top computer. If the use of lap top computers proves to be successful, these higher priced but more powerful computers that can run standard software may be the best equipment to use.

Mouse Device for Drawing

A recent acquisition of the Center was a mouse input device for the IBM computers. This was obtained to allow a student access to a computer assisted design (CAD) program for design and engineering work. The mouse provides another potential alternative input method as it replaces the keyboard for commands and data entry. The mouse obtained can be used with the PFS software used in the Center.

Technological Skill Training Interventions

Physically disabled students are often unable to manipulate writing tools, such as pencils and paper, to produce written output. Visually impaired students may be unable to produce readable output due to an inability to see materials and format written script on paper. Learning disabled students, while usually able to physically produce written output, often have difficulty producing readable text due to letter transformations, organization, and spelling problems. Hearing Impaired students have difficulties with verb tenses and the nuances of writing. Since written output is required as an integral part of college instruction, any

limitation on the ability to produce written materials will significantly affect college performance.

These limitations are addressed by using the computer and various software as skill-training interventions. The computer can overcome physical limitations on the manipulation of writing utensils by providing a means for physically disabled or visually impaired students to enter data that can then be printed to produce written text. As previously described, a variety of accessing methods can be used to allow physically or visually disabled students to enter data into the computer. When the computer is programmed with the appropriate software, academic skill enhancement and general knowledge base improvement is possible.

Word Processing Software

Word processing software can allow students to format the text and produce printed output in the required format. The ability of the computer to process large amounts of data and format printed output in a variety of forms allows students to accomplish a high volume of writing that would be difficult or impossible to do by other means. In addition, proofing and spelling software is available that can detect the errors normally made by learning disabled students and alert them to where editing is necessary. The Center uses the PFS Write program for general word processing, and has available Word Perfect, and PFS Professional Write for more sophisticated word processing needs such as in thesis or

dissertation construction.

For learning disabled students, the computer can provide the ability to create readable written output. Word processing software allows editing of material prior to the final printed output so that letter transformation and spelling errors can be corrected. With hand written or typed material this editing process is more laborious and may require the rewriting of extensive sections of text. The computer is thus able to allow learning disabled students to produce clearly expressed, readable written text.

Skill Building and Knowledge Base Software

In addition to benefits derived from the word processing software, programs such as Pro Sentence, Pro Grammar, Proteus, and HBJ Writer provide training in written content and organization. The Knowledge Master series for Apple computers provide general knowledge instruction, and the Study Skills program provides training in library skills and outlining strategies for research paper composition.

The technological, software, and skill training interventions used by the Center are summarized in Appendix I. This Appendix presents the equipment and software used to meet input and output needs in table form, with specification of the disability it is used for, the computer it runs on, the function of the equipment or program, and comments. Center staff continually assess new developments in computers and software to identify additional interventions that can meet student needs.

TECHNOLOGICAL INTERVENTIONS

INPUT

Intervention	Equipment	Disability	Sensory or Motor Skill Transference	Description
Optical Text Scanning	IBM PC, Omni Reader	PI, HI	Physically manipulated print to screen output	Used to overcome limitations on manipulating printed material.
Optical Text Scanning Enlarged Screen	IBM PC, Omni Reader, VTEK Monitor	VI	Visual standard print to visual enlarged print	Used to access printed material that are too small to be seen.
Optical Text Scanning Voice Synthesis	IBM PC, Omni Reader, VOTRAX or DECTAlk	VI, LD	Visual print to spoken text	Used to access printed material that can not be seen or read.
Optical Text Scanning Braille Print	IBM PC, Omni Reader, Braille Printer	VI	Visual print to touch print	Used to access printed material that can not be seen.
Transcription	IBM PC or Apple IIe	HI	Spoken text to visual print	Used to access spoken material that can not be heard.
Transcription Voice Synthesis	IBM PC, VOTRAX or DECTALK	VI, LD	Visual print to spoken text	Used to access printed material that can not be seen or read.

OUTPUT

Word Processing	IBM PC, Apple IIe	All	Written script to keyboard entry	Used to allow production of written text.
Word Processing Proofing	IBM PC or Apple IIe, Proofing Software	PI, LD, HI	Written script to keyboard entry	Used to compensate for problems in writing mechanics.
Voice Communication System	IBM Convertible, VOTRAX	SI	Speaking to keyboard entry with voice output	Used to allow vocal communication.
Portable Notewriting System	IBM Convertible or TRS 80 Model 100	PI, LD, VI	Written script to keyboard entry	Used to allow production of written in class notes.
Portable Writing System	IBM Convertible, Printer	PI, LD, VI	Written script to keyboard entry	Used to allow in class writing.
Computer Assisted Design (CAD)	IBM PC, Mouse	PI	Physical drawing to keyboard or mouse entry	Used to allow drawing, drafting, etc.